**THEORY**

- When a nucleus decays from an excited state to its ground state, it can emit the excess energy in the form of a gamma ray. Alternatively, if the wave function of an atomic electron overlaps the nucleus, that electron can be ejected in a process known as internal conversion.
- When an orbital electron is ejected, an electron from a higher energy shell jumps down to fill the vacancy and a characteristic x-ray is emitted in the process.
- The ratio of the probability for the nucleus to decay by internal conversion to γ-emission is called the Internal Conversion Coefficient (ICC), or \( \alpha_k \), where the subscript the shell of the ejected electron.

\[
\alpha_k = \frac{N_k \varepsilon_Y}{\omega_k N_Y \varepsilon_k}
\]

\( \omega_k \) - Fluorescence yield, \( N_k \) - x-ray peak area, \( N_Y \) - ray peak area
\( \varepsilon_Y \) - y-ray detector efficiency, \( \varepsilon_k \) - x-ray detector efficiency

**MOTIVATION**

- Measure ICCs to high precision and investigate the accuracy of theoretical calculations that include or exclude the atomic vacancy.
- Gain a better understanding of the \( \alpha_k \) value used in basic science and applications to help balance decay-scheme intensities, assist in assigning multipolarities and spins, etc.

**SETUP**

- We prepared a sample of ruthenium oxide by electrochemically depositing it on an aluminum backing and activating it with thermal neutrons at the Texas A&M TRIGA reactor (left) for 20 hours.
- Decay spectra were then recorded for roughly 120 hours with our HPGe detector (right), which has been precisely efficiency calibrated ±0.15% relative precision.

**IMPURITY ANALYSIS**

- Five series of decay and background spectra were taken over the course of roughly a month.
- Using the Maestro software package, we summed the decay series and corrected them using the background sums.
- Based on NNDC databases, impurities were identified and corrected for in the ICC calculation.

**AREA EXTRACTION**

- The ROOT framework developed by CERN was used to fit the structure containing the \(^{103}\text{Rh}\) gamma ray and \(^{153}\text{Gd}\) K x-rays.
- The master fit was comprised of a first order polynomial for the background, a skewed Gaussian for the gamma ray, and two Voigt functions for the \( K_{\alpha1} \) and \( K_{\alpha2} \) x-rays.
- The best fit parameters were found, with the normalized chi-squared value equal to 4.1; the master fit was decomposed and the skewed Gaussian function integrated.
- The area of the 39.76-keV \( \gamma \) peak, combined with the contaminant-corrected \( K \) x-ray area yielded a preliminary \( \alpha_k \) value of 134.6(19).

**RESULTS AND CONCLUSIONS**

- Our preliminary experimental value for the ICC of \(^{103}\text{Rh}\) demonstrates that the atomic vacancy created in the internal conversion process must be considered in theoretical calculations. This agrees with our measurements of other ICCs.

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